Project Code and Title

B.02.01.03.05 Hip and Knee Injury Model

Project Objective

Develop a finite element model of the human lower extremity with sufficient anatomic detail to investigate both bony and soft tissue injuries to the hip and knee under automotive crash loads.

Background

With the introduction of airbags into the automotive fleet, fatalities resulting from head and chest injuries have been greatly reduced. As a consequence of this, occupants are now surviving serious crashes, but are still sustaining significant injuries to their lower extremities. The biomechanics of these injuries are not fully understood. Analytical modeling, in combination with experimental testing, will provide essential information on the mechanisms and tolerances of hip and knee injuries.

Problem Definition

Understanding the complex problem of lower extremity injuries is difficult using only experimental methods. A detailed finite element model will be used in combination with experimental testing to provide needed insight into the mechanisms and tolerances of hip and knee injuries.

Research Approach

A detailed finite element model of the human lower extremity is being developed, including sufficient anatomic detail to investigate both bony and soft tissue injuries under automotive crash loads. This model will be used to study applications of interest to the automotive safety community.

Potential Impact/Application

All crashworthiness programs involving lower extremity injury mechanisms and tolerances.

RESOURCE REQUIREMENTS	FY95	FY96	FY97	FY98	FY99
Contract Money ($K)	125	200	240	240	240

Project Manager(s)

Mike Kleinberger (202) 366-4698

Project Tasks

Task	Title and Description
Task 1	Construct finite element model of pelvis and lower extremities including all skeletal components and biomechanically relevant ligaments, with primary emphasis on the hip and knee joints.
Task 2	Run preliminary simulations using material models available in the DYNA3D finite element analysis code. Initial simulations will include lateral loading of the pelvis (side impact) and loading through the foot due to floor pan intrusion with knee contact (frontal impact). These simulations should demonstrate the feasibility and sufficient level of detail of the model.
Task 3	Rerun preliminary simulations using improved material models (developed in project B.02.01.03.07). Validate pelvis and leg model with experimental data.
Task 4	Run simulations of major injury-producing loading scenarios for automotive occupants as documented by NASS analysis and experimental cadaver tests conducted by other NHTSA contractors.

Task	Start Date	Projected Completion Date	Status/Responsibility
1	9/94	3/96	Complete.
2	3/96	12/96	In progress. Toepan loading simulation has been run.
3	12/96	6/97	Improved material models being developed (see B.02.01.07)
4	6/97	6/98	